

# ADVAIT MEHLA

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## Education

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### Indian Institute of Technology Bombay

(Nov '20 - present)

- Major degree (with Honors) : Bachelors of Technology in Engineering Physics - **CPI : 8.91/10**
- Minor degree : Department of Electrical Engineering

## Scholastic Achievements

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- Awarded a **Branch Change** to **Engineering Physics** based on exemplary academic performance ('21)
- Currently hold a **Department Rank** of **9** out of **66** students in the Engineering Physics batch ('22)
- Secured a percentile of **99.923** among over **1 million** candidates in **JEE Mains** ('20)
- Awarded the **KVPY fellowship** by DST, Govt. of India **twice** with **All India Ranks 306** and **466** ('19, '18)
- Among the **top 450** students nationally selected for **Indian National Physics Olympiad(INPhO)** ('19)
- Among the **top 300** students nationally selected for **Indian National Jr. Science Olympiad(INJSO)** ('16)

## Key Projects

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### Characterising the Spectral & Polarimetric Response of CZT Detectors

(Nov '21 - present)

*Prof. Varun Bhalerao, Dept. of Physics IIT Bombay; Dr. Sujay Mate, Tata Institute of Fundamental Research*  
*Daksha is a proposed space telescope mission consisting of a pair of satellites to act as a high energy all-sky monitor. Cadmium Zinc Telluride detectors shall be used to analyse GRBs in the 20-200 keV energy range.*

- Simulated the interactions of photons with detectors using the **Geant4 toolkit** developed by **CERN**
- Studied literature on the various **interaction mechanisms** of X-ray and gamma ray photons with matter
- Created a **pipeline** to construct **response files** for inferring **source spectra** from the detected counts
- Involved in the development of a processing pipeline to implement **Compton Polarimetry** with **pixellated detectors** in order to **determine polarisation** of sources and estimate the Minimum Detectable Polarisation
- Work on the polarisation capabilities of Daksha was presented at the *Astrophysical Polarimetry in the Time-Domain Era* conference held at Politecnico di Milano - Lecco, Italy as a poster with me among the co-authors

### Team Member, GLEE | IIT Bombay Student Satellite Program

(May '21 - June '22)

*A 70+ member student team with the vision of making IIT Bombay a centre of excellence in space technology*  
*GLEE is a global collaborative mission that will conduct science on the lunar surface using ChipSats*

#### ◦ Instrumentation Subsystem

- Scrutinised components & constructed a multi-stage **readout circuit** for a PIN diode based **spectroscope**
- Tested and verified the functioning of the circuit by simulating input signals & analysing the output waveform

#### ◦ Communications Subsystem

- Designed several iterations of a 4cm x 4cm **prototype ChipSat** capable of processing and **wirelessly transmitting** data from the **lunar environment** gathered by **two sensors** interfaced with a microcontroller
- Learnt **embedded C** and implemented **UART** and **SPI** communication protocols to achieve transmission of data between multiple AVR microcontrollers and a personal computer

### Closed Loop LED Controller | Course Project

(Autumn '21)

*PH 233: Op-amp Circuits Lab, Prof. Pradeep Sarin, Department of Physics*

- Designed a **P-Type Controller** that regulates the intensity of an LED in accordance to external noise
- **Debugged** and **tuned** the circuit parameters after implementing it on a breadboard using operational amplifiers

### Analysis of the Nonlinear Dynamics of Neuronal Models | Course Project

(Autumn '21)

*PH567: Nonlinear Dynamics and Chaos, Prof. Amitabha Nandi, Department of Physics*

- Designed and constructed an **analog circuit** to mimic the Nagumo **neuronal model** and demonstrated the **action potential** and other **neuronal behaviour** by visualising signals on a digital oscilloscope
- Explored the **phase space** of the **Fitzhugh model** by numerically integrating the dynamical equations
- Observed how changes in stimuli can lead to a **bifurcation** that introduces **limit cycles** in the system

## Simulating Kirkwood Gaps

(July '21 - Sept '21)

*Krittika, the Astronomy Club of IIT-B (Summer Project)*

- Implemented a **Monte Carlo simulation** to evolve large distributions of asteroids over millions of years
- Observed the emergence of **Kirkwood gaps** in the **asteroid belt** along with features like the Jupiter Trojans
- Optimised simulation times by a factor of **6 to 12** via implementation of **parallelised code** and utilisation of **high performance computing** libraries like **OpenMP** and **CUDA Fortran**

## Encrypted Error-Correcting Digital Communication System | Course Project

(Spring '22)

*EE224: Digital Electronics, Prof. Maniraj Mahalingam, Department of Physics*

- Designed a peer to peer digital communication system that uses a (15, 11) **Hamming code** to automatically **detect and correct** any random bit flip error that may have occurred during transmission
- Implemented an **XOR cipher** using the output of an 8-bit synchronised **Pseudorandom Number Generator** as the encryption key

## Analysis of Exoplanetary data in Python | Course Project

(Spring '21)

*AE102: Data Analysis and Interpretation, Profs. Prabhu R., Amuthan R., Dept of Aerospace Engineering*

- Studied the various methods of **exoplanet detection** and measurement of the relevant parameters
- **Analysed correlations** among variables with **Linear Regression** & discussed **planetary classification**
- Observed the incidence of **orbital resonance** in **multiplanetary systems** and confirmed Kepler's Laws

## Positions of Responsibility

### Manager | Krittika, the Astronomy Club of IIT Bombay

(June '22 - present)

- Leading a team of **7 conveners** to organise & conduct events to propagate astronomy at IITB and beyond
- Spearheading the development of the **IIT Bombay Observatory** with an initial funding of INR 180K
- Hosted an observing session where **150+** students viewed various astronomical objects through telescopes
- Organized the **Krittika Summer Projects**, an **8-week** long program aimed at exposing students to astronomical research & received **100+** applications along with **international participation** for the first time

### Convener | Krittika, the Astronomy Club of IIT Bombay

(June '21 - April '22)

- Conducted a **session on astrophotography** and a hands-on **image processing** demonstration using Hubble raw data attended by **30+** astronomy enthusiasts, as part of a larger **Lecture Series** on astronomy
- Designed a Python-based **problem statement** on **Hertzsprung - Russell** Diagrams for the **Krittika Summer Projects** conducted for first year students and guided participants through solving it

## Key Courses

<b>Physics</b>	General Theory of Relativity, Gravitational Wave Physics & Astronomy*, Quantum Mechanics I, Quantum Mechanics II*, Photonics*, Classical Mechanics, Nonlinear Dynamics
<b>Mathematics</b>	Differential Calculus, Integral Calculus, Linear Algebra, Complex Analysis, Differential Equations I, Differential Equations II, Numerical Analysis
<b>Electronics</b>	Basic Circuits Lab, Op Amp Circuits Lab, Digital Electronics Lab, Microprocessors Lab*, Digital Systems, Electronic Devices, Signal Processing I, Image Processing*

## Technical Skills

\* To be completed by Nov '22

<b>Languages</b>	C/C++, Python, Fortran, MATLAB, $\text{\LaTeX}$
<b>Packages/Libraries</b>	NumPy, Matplotlib, SciPy, SymPy, Pandas, Numba, OpenMP, CUDA
<b>Other Software</b>	Geant4, Git, Proteus, Photoshop, LTspice, EAGLE, Arduino

## Extracurricular Activities and Interests

- Awarded **NASA Astronomy Picture of the Day** for processing raw data from the Hubble Space Telescope ('20)
- Captured images of several **deep sky objects** using basic equipment as an **amateur astrophotographer**
- Awarded a **cash prize** and an **internship offer** as **sole winner** out of **20+** teams in the **Astronomy General Championship** conducted by Nayam Innovations and Institute Technical Council, IITB ('22)
- Attended the 3-day **Vijyoshi National Science Camp** conducted at **IISc Bangalore** for facilitating interactions between KVPY Fellows and world-renowned researchers from various fields of science ('19)